

## Ultra Low Temperature Batteries (ULTB)

Completed Technology Project (2015 - 2017)



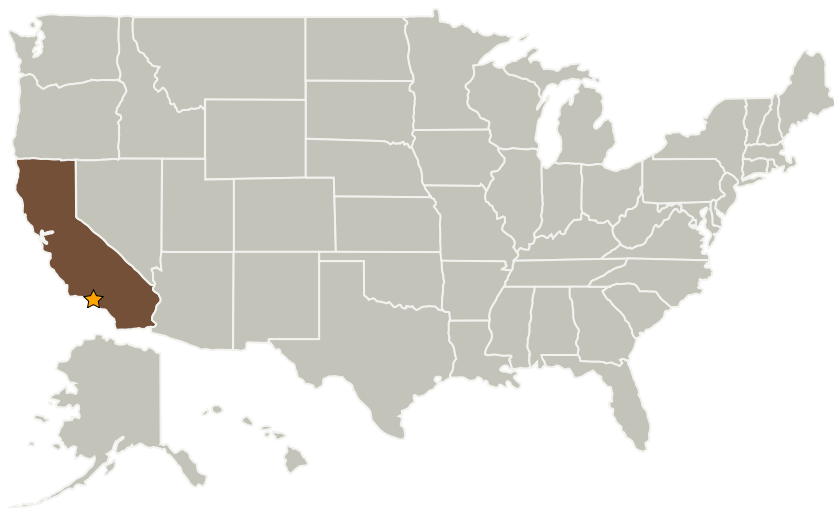
## Project Introduction

Develop low temperature batteries that enable an extended Europa Lander Mission architecture: Enable and increase the landed mission lifetime (relative to commercially available primary batteries) allowing science operations to proceed until an additional Europa Orbiter pass, Reduces the mass and power consumption to enable an additional science instrument and operations, Greatly enhances power margins, mass margins, and lifetime of the baseline mission

## Anticipated Benefits

NASA funded: This technology is required by the current Europa Lander baseline mission. The benefits of the improved specific energy and low temperature operation enable a mission to be executed to meet a minimum set of science requirements. NASA unfunded: This technology will benefit future deep space missions as it is the next step in high density chemical energy storage for extreme temperature operation. OGA: This technology will be made available to the aerospace industry via vendors that are working to produce the flight products. All other government agencies will have access. It is anticipated that many government agencies will benefit from the increased specific energy for low temperature operation. Commercial: Commercial Space Industry may benefit from the increased specific energy for low temperature operation by relaxing thermal design/management requirements on commercial s/c buses. Nation: Enables scientific discovery on the surface of Europa with high potential to impact other future deep space missions.

## Primary U.S. Work Locations and Key Partners



Ultra Low Temperature Batteries

## Table of Contents

Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	1
Organizational Responsibility	1
Project Transitions	2
Project Website:	2
Project Management	2
Technology Maturity (TRL)	2
Target Destination	2

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Jet Propulsion Laboratory (JPL)

**Responsible Program:**

Game Changing Development

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Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory (JPL)	Lead Organization	NASA Center	Pasadena, California

## Primary U.S. Work Locations

California

## Project Transitions

▶ **October 2015:** Project Start

✓ **September 2017:** Closed out

**Closeout Summary:** The primary (non-rechargeable) battery completed radiation testing and reached TRL4, possibly TRL5. This design has been baseline for the Europa Lander project and further environmental testing will be completed under that project. The rechargeable battery reached TRL4. The OWLB project focused on establishing methods that would provide the battery power necessary for executing successful missions in the extreme cold environment of the ocean worlds. Given the large distances these worlds are located from the Sun, mission operations in the extreme environmental conditions of very low temperatures and in high radiation, are further complicated by the need for reliable planetary protection protocols. The new power technology approaches identified by the project are a critical needed to enable such missions. OWLB focused technology development on three efforts: 1) high low temperature capable batteries with high energy density, 2) low temperature capable lithium-ion cells and 3) space rated regenerative fuel cells. The project was guided by emerging concept requirements for the Europa Lander mission results were used as emerging mission requirements evolved.

## Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>

## Project Management

**Program Director:**

Mary J Werkheiser

**Program Manager:**

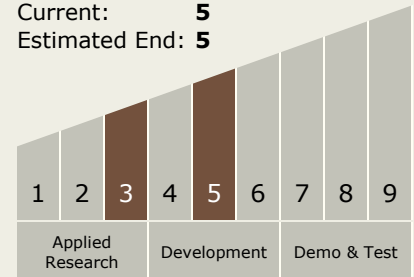
Gary F Meyering

**Principal Investigator:**

Thomas A Cwik

## Technology Maturity (TRL)

Start: 3  
Current: 5  
Estimated End: 5



## Target Destination

Others Inside the Solar System